

Appl. No.: 10/072,789
Amtd. Dated 11/24/2004
Reply to Office Action of 08/24/2004

REMARKS/ARGUMENTS

Applicants thank the Examiner for a thorough review of the above-referenced application and acknowledge with appreciation the Examiner's indication that Claims 2, 4, 5, 10, 12 and 13 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicants have amended independent Claims 1 and 9 to more clearly define the invention, as explained more fully below. Applicants have also amended dependent Claim 13 to correct the noted objections concerning dependency and amended dependent Claims 4 and 12 to correct a noted typographical error. Applicants have cancelled Claims 18-26 and have newly presented Claims 32-44 directed to the subject matter indicated as allowable in the Office Action. Applicants request reconsideration of Claims 1-17 and consideration of newly presented Claims 32-44 in view of the Amendments and Remarks set forth herein.

Petition for Acceptance of Color Photogragh as Drawing

The Office Action requested Applicants submit a copy of the Petition to Accept Color Photograph as Drawing. Applicant submits that the subject Petition and three sets of color photographs were submitted with the originally filed application and notes that the color photograph (Figure 8) was included with the application when the application was published on March 25, 2004 (Pub. No. US 2004/0055666). As requested in the Office Action, Applicants submit a copy of the Petition to Accept Color Photograph as Drawing filed on February 8, 2002.

Invention

The present invention provides a structural member defining a first region comprising at least a portion of the exterior of the structural member. The first member is characterized by comparatively high operational stress, which as explained in the specification can be identified from known mathematical equations and computational techniques, such as finite element analysis. The structural member further includes a second region that comprises at least a portion of the exterior of the structural member and that has a more refined grain structure than

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other portions of the structural member. The second region of the structural member is formed by partial-penetration or full-penetration mixing and is positioned such that the second region at least partially encompasses the first region. Advantageously, the second region selectively improves the strength, toughness and fatigue resistance of the structural member in the first region.

Conventional methods of improving the material properties of structural members have typically involved performing relatively complex thermal and mechanical treatments to the structural member, such as heat treatments and rolling, which can be time consuming and expensive. In addition, because conventional thermal and mechanical treatments must typically be performed to the entire structural member, these conventional treatments are generally not appropriate for relatively large structural members or for structural members having relatively complex shapes or configurations.

Given these limitations on conventional thermal and mechanical treatments, it is believed the inventors of the present invention are the first to provide a structural member and corresponding method of manufacture in which regions of comparatively high operational stress are identified and processed to have a more refined grain structure than other portions of the structural member. The structural members of the present invention not only have improved strength, toughness and fatigue resistance in the region of comparatively high operational stress, but, in contrast to conventional structural members, can be manufactured more efficiently in terms of time and expense. Moreover, because the grain structure of the structural members of the present invention are selectively refined in the regions of comparatively high operational stress, as opposed to the entire structural member, structural members according to the present invention are not subject to the size and configuration limitations of structural members produced using conventional thermal and mechanical treatments.

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The Objections to Claims 13, 19-25 and 27-31 Are Overcome

The Office Action objected to the dependency of Claim 13 and the form of the preamble of Claims 19-25 and 27-31. Applicants have amended Claim 13 to correct the noted informalities. Applicants have cancelled Claims 19 – 25 and 27 – 31 and, thus, the objection to the form of these claims is moot.

The Rejections Directed to Claims 1, 3, 6-9, 11, 15, 16-17 Are Overcome

The Office Action rejected Claims 1, 3, and 7 under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 4,395,296 to Abrams or U.S. Patent No. 4,816,087 to Cho. The Office Action rejected Claims 1, 3, and 6 under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 4,883,545 to Matlock. The Office Action rejected Claims 1, 3, 7, and 8 under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 4,693,747 to Bretz et al. The Office Action rejected Claims 9, 11, 15 and 16 under 35 U.S.C. § 103(a) as being obvious over the Bretz '747 patent. The Office Action rejected Claim 17 under 35 U.S.C. § 103(a) as being obvious over the Cho '087 patent.

The Abrams '296 patent, Cho '087 patent, and Matlock '545 patent each disclose using thermal and mechanical treatments to form a structural member having a duplex microstructure in which the structural member has relatively fine grains at the surface of the structural member and relatively coarse grains at the center of the structural member (See Figure 3a of the Abrams '296 patent; see Col. 4, lines 63-68, through Col. 5, lines 1-10, of the Cho '087 patent; and see Col. 2, lines 35-38, of the Matlock' 545 patent). In contrast, as recited in amended independent Claims 1 and 9, the first region of the structural member, which is characterized by comparatively high operational stress, comprises at least a portion of the exterior of the structural member, not just the center of the structural member as taught in the Abrams '296 patent, Cho '087 patent, and Matlock '545 patent. In addition, Claims 1 and 9 recite that the second region of refined grain structure is formed by partial-penetration or full-penetration mixing, not heat

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treating and working the structural member with a roller or die as disclosed in the Abrams '296 patent, Cho '087 patent, and Matlock '545 patent. As defined in the specification (page 9, lines 31-33), "mixing" comprises stirring the structural member with a non-consumable rotating friction stir welding probe.

The Bretz '747 patent discloses using powder metallurgy to obtain an aluminum alloy product having both fine and coarse grain structures. Specifically, the product is formed by mixing or layering first and second powders, wherein the first powder is selected to produce a fine grain structure and the second powder is selected to produce a coarse grain structure, and then compacting and hot pressing the powder into an ingot or billet. In contrast, as recited in amended independent Claims 1 and 9, the second region of refined grain structure is formed by partial-penetration or full-penetration mixing, which is clearly defined in the specification as stirring with a non-consumable friction stir welding probe.

Accordingly, Applicants submit that the Abrams '296 patent, Bretz '747 patent, Cho '087 patent, and Matlock '545 patent do not teach or suggest, either singly or in combination, a structural member having a first region characterized by comparatively high operational stress and comprising at least a portion of the exterior of the structural member, and a second region of refined grain structure that is formed by partial-penetration or full-penetration mixing, as recited in amended independent Claims 1 and 9. Thus, Applicants respectfully submit that amended independent Claims 1 and 9, and the claims depending therefrom, include recitations that patentably distinguish the claimed invention over the cited references.

The Rejections Directed to Claims 18-25 and 26-31 Are Moot

The Office Action rejected Claims 18-25 and 26-31 under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,302,315 to Thompson alone or in combination with the Bretz '747 patent or the Cho '087 patent. While Applicants disagree as to the basis for the rejection of Claims 18-25 and 26-31, Applicants have cancelled the subject claims without prejudice in order to facilitate the prosecution and allowance of the remaining claims and the newly presented claims. Accordingly, Applicants submit that the rejections directed to Claims 18-25 and 26-31

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are now moot. Applicants expressly reserve the right to represent the cancelled claims and/or to file a new application directed to the subject matter of the cancelled claims.

Newly Presented Claims 32-44 Should Be Allowed

Applicants have newly presented Claims 32-44. In this regard, newly presented independent Claim 32 is directed to the subject matter recited in original Claims 2 and 10 and newly presented independent Claim 39 is directed to the subject matter recited in original Claims 4, 5, 12, and 13. Since the Office Action indicated that Claims 2, 4, 5, 10, 12, and 13 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, Applicants submit that newly presented Claims 32-44 should be allowed.

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CONCLUSION

In view of the foregoing remarks, Applicant respectfully submits that Claims 1-17 and 32-44 of the present application are in condition for allowance. It is respectfully requested that a Notice of Allowance be issued in due course. Examiner Wyszomierski is encouraged to contact Applicants' undersigned attorney to resolve any remaining issues in order to expedite examination of the present application.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,



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CERTIFICATION OF FACSIMILE TRANSMISSION

I hereby certify that this paper is being facsimile transmitted to the U.S. Patent and Trademark Office at Fax No. (703) 872-9306 on the date shown below.

Sarah B. Simmons
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November 24, 2004
Date

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